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ULTRATHIN PLATE MULTI-STAGE CASCADE CONNECTION MULTIPLEX MODE FILTER

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ULTRATHIN PLATE MULTI-STAGE CASCADE CONNECTION MULTIPLEX MODE FILTER

[Chohakuban junzoku tajunmodo fuiruta]

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[There are no amendments to this patent.]

Claims

1. A type of ultrathin plate multi-stage cascade connection multiplex mode filter characterized by the following facts: by means of piezoelectric blank, an ultrathin oscillation portion and a thick ring-shaped peripheral portion for supporting the aforementioned oscillation portion are integrated to each other; multi-stage cascade connected multiplex mode filter elements, each of which has divided electrodes separated from each other by a prescribed gap, are arranged on the surface of the aforementioned oscillation portion; in this ultrathin plate multi-stage cascade connection multiplex mode filter, the divided electrode shape of at least one of the aforementioned multi-stage cascade connected multiplex mode filter elements is different from that of the others.

2. The ultrathin plate multi-stage cascade connection multiplex mode filter described in Claim 1 characterized by the fact that together with the aforementioned divided electrode shape, the direction and shape of the electrode lead portion extending from the two electrodes of the aforementioned divided electrode to the end portion of the blank are also different from those of the other [multiplex mode filter element].

3. The ultrathin plate multi-stage cascade connection multiplex mode filter described in Claim 1 or 2 characterized by the fact that the aforementioned divided electrodes in multiple groups are cascade connected and are arranged on the surface of a single ultrathin oscillation portion.

Detailed explanation of the invention

[0001]

Industrial application field

This invention pertains to the configuration of the ultrathin plate multi-stage cascade connection multiplex mode filter.

[0002]

Prior art

In the conventional scheme shown in Figures 5 (a) and (b), by means of, say, etching, a recessed portion is formed on one surface of a piezoelectric blank, such as an AT-cut quartz blank (1). Its bottom surface is used as a ultrathin plate oscillation portion (2), and a thick ring-shaped peripheral portion (3) that supports the periphery of said oscillation portion (2) is formed integrated with said oscillation portion (2), so as to form a ultrathin plate quartz oscillator with the mechanical strength of said oscillation portion (2) maintained. In this ultrathin plate quartz oscillator, an electroconductive film is coated on the depressed side to form a total-surface electrode (4). On the opposite flat surface, at nearly the center of said oscillation portion (2), a group of divided electrodes (5) and electrode lead portions (6), (6), which extend from the two electrodes to the end portions of the blank, are arranged. For the multi-stage

cascade connected filter having ultrathin plate multiplex mode filter elements, which have the same central frequency, terminal impedance and pass bandwidth, connected as multiple stages to each other, the attenuation of the attenuation band near the pass band is high, and the skirt characteristics also are excellent. Due to the excellent filter characteristics, [the filter] can be used in the mobile communication, etc., which have high requirement on high-frequency performance and miniaturization. However, in the ultrathin plate multi-stage cascade connection multiplex mode filter with the aforementioned configuration, spurious [radiation] is generated on the higher-frequency side of the filter pass band of each filter element. As the filter is made of multiplex mode filter elements of the same [characteristics], the skirt characteristics become steep, while suppression of the spurious [radiation] level is insufficient. Consequently, for the filter which requires high attenuation on the two sides of the pass band of digital mobile communication, etc., the attenuation becomes insufficient due to the spurious [radiation] on the higher-frequency side.

[0003]

Purpose of the invention

This invention provides a type of ultrathin plate multi-stage cascade connection multiplex mode filter characterized by the fact that it can get rid of the disadvantage of the aforementioned conventional ultrathin plate multi-stage cascade connection multiplex mode filter, as it can well suppress

the spurious [radiation] by adopting a combination of ultrathin plate multiplex mode filter elements.

[0004]

Abstract of the invention

In order to realize the aforementioned purpose, this invention provides a type of ultrathin plate multi-stage cascade connection multiplex mode filter characterized by the following facts: by means of a combination of ultrathin plate multiplex mode filter elements, spurious [radiation] can be well suppressed; the divided electrode shape of at least one element of the multiplex mode filter elements connected in cascade is designed differently from that of the other [element], and, together with the aforementioned divided electrode shape, the direction and shape of the electrode lead portion extending from the two electrodes of the aforementioned divided electrode to the end portion of the blank are also different from those of the other [multiplex mode filter element].

[0005]

Application examples

In the following, this invention will be explained in more detail with reference to application examples illustrated by figures. Before explanation of the application examples, first of all, let's look at the configuration and characteristics of

the filter made of two ultrathin plate multiplex (double) mode filter elements illustrated by Figure 5. As shown in Figure 5(a), in the conventional scheme, the filter elements used have identical electrode configuration. Consequently, as shown in Figure 5(c), the filter elements connected in cascade to each other have totally identical spurious characteristics. As a result, as shown in Figure 5(d), the spurious characteristics take place at the same position as that in the case of one filter element, and cannot be suppressed. The same disadvantage as explained in the above takes place.

[0006]

The ultrathin plate multi-stage cascade connection multiplex mode filter of this invention designed for solving the problem has the following configuration. Figure 1(a) and (b) are a plane view and an A-A cross-sectional view of an application example of the ultrathin plate multi-stage cascade connection multiplex mode filter of this invention, respectively. Divided electrodes (5) and (5') formed on ultrathin plate oscillation portion (2) have different shapes. That is, as shown in Figure 1(c), with respect to the dimensions H and L of the divided electrodes, the ratio H/L values are different from these two divided electrodes. As can be seen clearly from Figure 2(a) and (b), the attenuation characteristics of these multiplex mode filter elements are different from each other as depending on the shape of the divided electrode and the spurious [radiation] generating position. Consequently, when the two filter elements are connected in cascade to each other, the [spurious radiations]

cancel each other and the spurious level can be lowered as shown in Figure 5(c). As a matter of fact, as the terminal impedances of the multiplex mode filter elements are in agreement to each other, the ratio of H/L is changed for different elements while the area of the divided electrode that determines the aforementioned value [of the terminal impedance] is maintained constant. However, it is well known that when the ratio of H/L alone is changed, the coupling degree of oscillation among the divided electrodes varies, and the pass bandwidth varies. Consequently, inter-electrode gap G is selected to be an appropriate gap, and the multiplex mode filter elements with the same pass bandwidth are connected in cascade.

[0007]

Figure 3 is a plane view illustrating the second application example of the ultrathin plate multi-stage cascade connection multiplex mode filter of this invention. In this application example, divided electrodes (5) and (5′) are different from each other with respect to the directions and extension shapes of electrode lead portions (6), (6), and (7), (7) extending from the two electrodes of divided electrodes (5) and (5′) toward the end portions of the blank. That is, after electrode lead portions (6) and (6) are extended in the oscillation transportation direction, they are bent by 90° and ....[illegible].... blank (1) ...[illegible]... extended in the oblique direction of about ... [illegible]5°. As the spurious [radiation]s generated in between electrode lead portions (6), (7) and total-surface electrode (4) are different from each other and depend on the directions and

shapes of electrode lead portions (6), (7), when the two filter elements are connected in cascade, the spurious [radiation]s cancel each other, and the spurious level is lowered. However, as the frequency is increased, the demand on miniaturization becomes higher. As a means to meet this demand, a scheme of multi-stage multiplex mode filter in which multiple groups divided electrodes are cascade connected on the surface of a oscillation portion of an ultrathin plate has been proposed in the past.

[0008]

Figure 4 is a plane view illustrating another application example of the ultrathin plate multi-stage cascade connection multiplex mode filter in this invention. On a single ultrathin plate oscillation portion (2), multiple groups of divided electrodes (5), (5′) with different shapes are arranged, and, at the same time, the directions and shapes of electrode lead portions (8), (9) extending from one side of the two electrodes are different from each other. The same effect can be displayed by this configuration. In the aforementioned application examples of this invention, AT-cut quartz blank was used as the ultrathin plate multi-stage cascade connection multiplex (double) mode filter. However, this invention is not limited to the quartz blank. Other types of piezoelectric blanks may also be used as well. Or, it is possible to increase the number of the divided electrodes to triple or more multiplex mode filter. Also, for the practical application, the H/L ratio is in the

range of 1-3, and the difference among the elements can be selected appropriately.

[0009]

Effects of the invention

With the aforementioned configuration of this invention, by simply changing the shape of the divided electrode or by changing the direction and shape of the electrode lead portion from the two electrodes of the divided electrode toward the end portions of the respective blanks, it is possible to suppress the spurious [radiation] and thus to play a significant effect in realizing the ultrathin plate multi-stage cascade connection multiplex mode filter.

[0010]

Brief explanation of the figures

Figure 1: (a), (b) and (c) are plane view, A-A cross-sectional view, and partially enlarged view of the divided electrode, respectively, of an application example of the ultrathin plate multi-stage cascade connection multiplex mode filter of this invention.

Figure 2: (a), (b) and (c) are schematic diagrams illustrating the basic spurious characteristics of the multiplex mode filter elements of the filter and the multi-stage cascade connected filter in this invention.

Figure 3: It is a plane view illustrating the second application example of the ultrathin plate multi-stage cascade connection multiplex mode filter of this invention.

Figure 4: It is a plane view of an application example of the ultrathin plate multi-stage cascade connection multiplex mode filter formed by cascade connecting multiple groups of divided electrodes on the oscillation portion of an ultrathin plate.

Figure 5: (a) is a plane view illustrating the configuration of a conventional ultrathin plate multi-stage cascade connection multiplex mode filter. (b) is an A-A cross-sectional view of the aforementioned configuration. (c) and (d) are schematic diagrams illustrating the basic spurious characteristics of a single multiplex mode filter element and the basic spurious characteristics of the configuration made of multi-stage cascade connected elements, respectively.

Symbols

1. AT-cut quartz blank
2. Oscillation portion
3. Ring-shaped peripheral portion
4. Total-surface electrode
5, 5′. divided electrode
6, 7, 8, 9. Electrode lead portion

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5度程度斜の方向に延長したものである。電極リード部6、7と全面電極4との間で発生するスプリアスは電極リード部6、7の方向及び形状により発生位置が異なる為、これら両フィルタ素子を縦続接続した場合、更に互いに打ち消し合いそのレベルを低減することができる。ところで、フィルタ素子においては高周波化と共に小型化への要求が高まっておりこれに応える手段の一として以前より超薄板の振動部表面に分割電極を複数組縦続接続した多段多重モードフィルタが提案されている。

【０００８】図４は本発明をこの超薄板多段縦続接続多重モードフィルタに用いた他の実施例を示す平面図であり、単一の超薄板振動部２に複数組の互いに異なる形状を有する分割電極５、５´を配置すると共に両電極の一方から延びる電極リード部８、９の方向及び形状を夫々異なった構成とし上述の実施例と同様の効果を図るものである。以上ＡＴカット水晶素板を用いた超薄板多段縦続接続多重（２重）モードフィルタを実施例に本発明を説明したが、本発明はこれのみに限定される必要はなく他の圧電素板を用いたものであってもよく、又分割電極数を増やした３重或はそれ以上の多重モードフィルタであってもよいことは自明である。尚、Ｈ／Ｌの比は実用的には１乃至３の範囲であって、各素子間の差が大きくなるよう適当に選択すればよい。

【０００９】

【発明の効果】本発明は以上説明した如く構成するものであるから分割電極の形状を変えるのみ或は更に分割電極の両電極が夫々の素板端部に向かって延びる電極リード部の方向及び形状を変えることによってスプリアスを抑圧した超薄板多段縦続接続多重モードフィルタを実

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現する上で著しい効果を奏する。

【００１０】

【図面の簡単な説明】

【図１】（ａ）、（ｂ）及び（Ｃ）は本発明に係る超薄板多段縦続接続多重モードフィルタの一実施例を示す平面図、Ａ－Ａにおける断面図及び分割電極の部分拡大図。

【図２】（ａ）、（ｂ）及び（Ｃ）は夫々本発明におけるフィルタの各多重モードフィルタ素子及び多段縦続接続したフィルタの基本的スプリアス特性を説明する減衰特性の模式図。

【図３】本発明に係る超薄板多段縦続接続多重モードフィルタの第２の実施例を示す平面図。

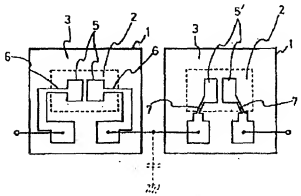
【図４】本発明を超薄板の振動部上に複数組の分割電極を縦続接続して構成した超薄板多段縦続接続多重モードフィルタの実施例を示す平面図。

【図５】（ａ）は従来の超薄板多段縦続接続多重モードフィルタの構成を示す平面図、（ｂ）はそのＡＡにおける断面図、（ｃ）及び（ｄ）は各多重モードフィルタ素子単体の場合の基本的なスプリアス特性及び各素子を多段縦続接続した構成における基本的なスプリアス特性を説明する減衰特性の模式図。

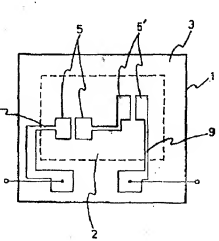
【符号の説明】

１・・・ＡＴカット水晶素板
２・・・振動部
３・・・環状囲繞部
４・・・全面電極
５、５´・・・分割電極
６、７、８、９・・・電極リード部

【図３】



【図４】



【図5】